Introduction

An archaeological survey was conducted by the author at Leona Bay on the island of Tutuila, American Samoa (Fig. 1). This work was carried out at the request of Edward K. Noda and Associates of Honolulu on behalf of the Department of Public Works, American Samoa Government, as part of an Environmental Assessment for a proposed commercial boat harbour. Fieldwork was undertaken in American Samoa between March 30th and April 2nd of 1987 in conjunction with other consultants carrying out their investigations.

The primary statutory authority for this work and related compliance activities is Section 106 of the National Historic Preservation Act, as amended. This act provides that "...any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking...take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register." Other federal and local historic preservation statutes may be applicable as well.

The proposed project is designed to provide a facility for the Queen Samalamina, an inter-island cargo and passenger vessel, as well as smaller domestic commercial fishing boats. The design will involve dredging a 140 x 700 ft. entry channel through the reef (depth of 15 ft. below m.s.l.), dredging a 200 ft. sq. turning basin (depth of 12 ft. below m.s.l.), and dredging a 260 x 100 ft. berthing area (depth of 6 ft. below m.s.l.). In addition, there will be a 330 ft. long breakwater with crest elevation at 12 ft. above m.s.l., a 300 ft. long revetted aisle with crest elevation at 10 ft. above m.s.l., and a revetted fill area with an elevation 8 ft. above m.s.l. The construction plan is illustrated in Fig. 2 (see Edward K. Noda and Associates 1986 for further details).

As may be seen on the Fig. 2 map of the proposed Leona Harbor construction plan, virtually the entire project will be on the reef flat near the center of the shoreward edge of Leona Bay. There will be virtually no construction disturbance to shoreline areas above the high tide level.

Background Research

Prior to fieldwork, all available archaeological reports and documents were obtained concerning archaeology in American Samoa. These included Frost (1975, 1978), Kennedy (1970).
contained a listing all known archaeological sites in the Leona area.

In addition, relevant sources relating to the archaeology of Western Samoa were also consulted. The most pertinent information in this regard concerned the reports on the submerged offshore Lagoa site in Mulifanua on the island of Upolu (Green 1974; Jennings 1974).

Mr. Stan Sorensen, Historic Preservation Officer for American Samoa, was also contacted before and during the survey. Mr. Sorensen proved most helpful in providing copies of reports and information concerning the status of archaeological research in American Samoa (particularly several recent and as yet unreported projects).

Dr. Barbara Keating of the Hawaii Institute of Geophysics was contacted concerning information on Samoan geology, and in particular, the question of island subsidence. The investigations at Mulifanua makes such an inquiry particularly relevant. Here archaeological deposits dating to 1,000 B.C. (Bellwood 1979:314) were found within a well-cemented coral crust nearly 1 meter thick and beneath 1.8 meters of water at a location 114 meters off-shore (Jennings 1974). These deposits evidently extended downward in unconsolidated coral and sand to a depth of 3 to 3.7 meters below the coral crust. It is therefore quite clear that early sites in many areas may be buried offshore in lagoonal deposits of the coral reef as a result of geological subsidence. The relevance of information on island subsidence, therefore, is apparent for the work at Leona Bay, which will involve the dredging of shallow offshore reef deposits.

Dr. Keating (personal communication April 1987) indicated that while there have been no specific studies of subsidence in American Samoa, it would certainly be an on-going process on that island. Studies in Hawaii indicate that a geologically recent volcanic island can subside as much as 14.4 cm in 60 years, though the rate may be much less for geologically older islands (Moore 1987:87). Subsidence, however, may be much more rapid in certain geologically active regions. As Moore indicates, "during the November 1975 magnitude 7.2 earthquake, a 25-ke-long zone along the southeast coast of Hawaii subsided as much as 3.5 m" (Moore 1987:90, citing Tilling et al. 1976).

Using the general long term subsidence rate of 14.4 cm in 60 years, it can be calculated that a 2,000 year old coastal archaeological site would now be 4.8 meters below sea level, and that a 3,000 year old site would be 7.2 meters below sea level. Assuming the applicability of this rate (or even half of this rate) for American Samoa, it is clear that shallow reef flats, such as found at Leona Bay, have the potential for containing
early archaeological deposits. Detailed geological studies relating to subsidence in American Samoa undoubtedly could refine a predictive model for early sites. But lacking such studies, and in light of the evidence at Mulifanua and subsidence studies elsewhere, there appears to be at least a reasonable chance that early off-shore sites site may be present in American Samoa.

The Archaeology of Leone

In 1961 and 1962, archaeological surveys by Yohihiko Sinoto and William Kukuchi located several sites in and around Leone (Kikuchi 1963). Among other investigations, they test excavated 5 sites in Leone. They describe the results as follows:

...house foundation sounds and exposed fireplaces in the village or in banks along the beach. All cultural deposits observed in the sites proved to be postcontact. Metal nails and glass pieces were found throughout the deposits. Only one adz was recorded from the excavation (Emory and Sinoto 1965).

In terms of the present project, the most relevant sites are a petroglyph, located on a long shelf-like rock exposure in the bay, and a whetstone site, located on a rocky point and a small islet at the north end of the bay (see Fig. 3). These sites are numbered As-34-21 and As-34-17 (see Clark 1980:89-91), respectively (the old numbering system of Kikuchi listed the sites as T-128 and T-143, respectively (Kikuchi 1953:94-102).

The shelf on which the petroglyph site is located is called Papaloa. Though Kikuchi (1964:164) describes it as being approximately 150 to 200 ft long, its actual length is closer to 600 ft. The section containing the petroglyphs is approximately 260 ft. in length. Kikuchi (1964:164) also mistakenly identifies the shelf as being formed of volcanic ash. In actuality, the rock consists of a lightly cemented coarse volcanic sand with a very slight admixture of coralline sediments; it is definitely sedimentary in nature. Although the rock is relatively hard as a mass, the individual sand grains are easily dislodged when rubbed or abraded.

Kikuchi recorded a total of 67 petroglyphs having the single motif of a circle of small pecked holes surrounding an interior hole (see Figs. 4, 5, 6, 7, 8, and 9). Kikuchi (1964:165) notes that in addition to the four groupings of circular motifs, there is a

...cluster of carved lines....There are indications of a human figure, a paddle and a
human foot. On the adjoining shelf of rock, west of the central shelf, several petroglyphs were found. One seems to be a drawing of a squid or octopus. The other two carvings are difficult to interpret.

Kikuchi (1964) considers all of the petroglyphs to be pre-European. At the time of his work there was one modern name—"Sua"—recorded on the rocks (Fig. 7).

Kikuchi also found the circle motif on a single petroglyph rock on the island of Tau on the coastline behind Fitiuла village. These carvings were said to have been made on vesicular basalt (Kikuchi 1964:167).

Similar petroglyphs have not been recorded from other Polynesian islands (Kikuchi 1964:166).

The other site recorded by Kikuchi was that of a cluster of whatstones, located on a basalt outcrop at the shoreline margin near Apoliaa Point on the western end of Leone Bay (see Fig. 3. Kikuchi (1963:152) says very little about this site, indicating only that "Site T-143, represents a cluster of elliptically shaped facets on a low-lying rock shelf which at high tides is covered by the sea."

The next archaeologist to conduct investigations in Leone was Janet Frost in 1972 (Frost 1976, 1978). She excavated two house foundations in the village of Leone and within 100 meters of the coast. A charcoal sample associated with a burial sealed beneath an illlilili floor produced a date of A.D. 1410 (uncorrected; Frost 1976:31).

The most recent archaeological observations in Leone prior to the present project were made by Kennedy in 1985. Although Kennedy did not record any new sites, his observations concerning the Papaloa rocks petroglyphs are of direct interest. After noting that the rock slabs on which the petroglyphs were made are now "full of modern markings," he observes that

Mixed in among the more prevalent modern carvings are what is left of the prehistoric ones. Many are in a state of rapid disrepair due to wave action and one must wonder as to their antiquity. The modern ones placed on the same rock sometime in the past twenty years already show signs of noticeable wear. The Papaloa rocks themselves are made of soft ash tuff and seem especially susceptible to this type of wave disintegration (Kennedy 1985:6).
Kennedy (1985:4) also reports that he was told by several informants that the present shoreline was 100 meters inland from its present location at the end of World War II. This suggests to him the possibility that submerged archaeological deposits may be present in Leone Bay, as was the case at Nuifanua in Western Samoa (Kennedy 1985:5).

Archaeological Observations: the Present Project

Field survey for the present project encompassed an area of approximately 16 acres in Leone Bay. The shallow reef flat was walked from the Papaloa rocks, to the whetstone site, to Niiaueve Rock, to a coral rubble spit near the probable submerged river channel, and back to the eastern end of Papaloa rocks. A total of 3 visits were made to the project location on separate days.

The Petroglyph Site (As-54-21)

The revised measurements for Papaloa rock and the area encompassed by the petroglyphs have already been mentioned (600 ft. and 260 ft., respectively). It was also noted that the rock is not volcanic tuff but rather a lightly cemented coarse volcanic sand with slight admixture of coralline sediment. The southeastern edge of the petroglyph figures is 374 ft. from the brass cap survey station located on the shoreline near the road (station no. 2).

The overall configuration of Papaloa rock suggests that it may have once been part of the original shoreline of Leone Bay, which may at one time have connected with Apolania Point (Photo 1). The reef channel, to the south, in fact suggests that the original drainage for the Pala Lagoon and Laafu Stream was not at its present location but rather at the location of the channel. Pala Lagoon, therefore, may have been much larger at some time in the past. The present shoreline between the southeastern tip of Papaloa rock and the emergence of the old stream channel onto the reef, is shown in Photo 2.

With respect to the changed stream drainage pattern and shoreline, it is of interest that two informants mentioned dredging by the U.S. Army during World War II (personal communications, Napoleone Tuitelaleapaqa, attorney, and Gala'i Pouelii, Secretary, Office of Samoan Affairs). Frost (1978:52) also mentions that, Occupants of the village described considerable bulldozing activities in the area during the World War II military occupation. Cement pillboxes, a cement reservoir on the
river, and ditches behind Leone all attest to these activities.

It is clearly possible, therefore, that the Aray work resulted in changing the stream flow pattern and the point at which it discharges into the bay. It is also possible that the peninsula on which the dispersary is located is entirely artificial fill. Given this scenario, which cannot be proved with the presently available information, Papaloa rock may have been buried under shoreline sand and silt and not accessible for carving petroglyphs as recently as the early 1940's.

In contrast to such a scenario, another informant, John Knewbuhl, indicated that he remembers swimming around the rocks where the petroglyphs are located as a kid in the 1920's, though he never saw the petroglyphs. This information, of course, suggests that Papaloa rock may be a relatively old feature of the bay and that the shoreline has not changed since World War II. The fact that Mr. Knewbuhl did not see the petroglyphs, however, does not necessarily indicate their absence at that time, as they could easily go unnoticed by a child.

At this time it is not possible to decide between the two interpretations. However, further research, particularly the search for World War II aerial photographs, could perhaps clarify the situation.

Initially the circle motifs proved very difficult to distinguish due to the great quantity of recent name carving (Photo 3 and 4). However, a large number of such motifs were eventually found (Photos 4, 5, and 6). Many of them, however, were quite faint, and some could not be found despite a careful comparison with the maps of Kikuchi (see Figs. 5-9). Since the maps of Kikuchi appeared to be quite accurate representations, it was felt that the reason for the missing motifs be due to the ongoing process of rapid erosion of the rock. This erosion, as may be seen in Photo 1, is very apparent with respect to concerning the overall configuration of the rock. Regarding the petroglyphs, a very faint date of 1966 was observed (Photo 5), along with the "SUE" originally recorded on one of Kikuchi's drawings (Fig. 7; Photo 4). Both of these glyphs of known date appear to be relatively worn and smoothed, suggesting that in just 20 to 25 years a substantial amount of weathering has occurred. Dates of 1977 and 1987 were also observed.

The carved line patterns recorded by Kikuchi (Fig. 6) were only faintly visible, and the human figure, canoe paddle, and human foot mentioned by Kikuchi (1964:165) could not be observed (see Photo 5). Similarly, the squid or octopus petroglyph and nearby carvings (Fig. 9) could not be seen despite knowledge of their exact location from Kikuchi's map. Presumably these have faded away as a result of erosion.
The Whetstone Site (As-34-17)

This site, located near Apolima Point and also including Niuaveve Rock, was only briefly visited. Photos 7 and 8 showing the grinding facets in the basalt outcrop and a nearby boulder. The latter is interesting because it has a linear groove for a grinding facet in addition to the more usual round, oval, and elliptical shapes (Photo 8). There are approximately 20 grinding facets at this site.

Despite a search, no broken or residue adze material (flakes, preformas, blanks, broken adzes or partially ground adzes) could be found around the whetstones. Apparently, the whetstones were used only for final finishing, and breakage was not a problem at this stage of the manufacturing process.

Alternate Sites for Harbor Construction

There are at present 5 alternate sites for harbor construction. These are Pala Lagoon, Fagasa, Faaamalo, Fagalii, and Asili. No archaeological investigations have been undertaken in these areas. Thus, before these locations can be suitably evaluated, it will be necessary to conduct archaeological surveys. Submerged offshore archaeological deposits would be a possibility at all of these locations, as at Leone Bay.

Conclusion

Two previously recorded sites were investigated during the archaeological reconnaissance of Leone Bay for the proposed harbor construction project. These sites included a rock shelf that contains petroglyphs, and also a whetstone site. The whetstone site is well outside the construction zone, and the petroglyphs, while much closer, are still beyond the area that will be affected by dredging and filling activities.

Investigations show that there is reason to question the previously assigned prehistoric age of the petroglyphs. The rock where they are found erodes very easily; packed names and dates only 20 to 25 years old already show considerable wear. Also, some of the circle motifs and other designs previously recorded by Kikuchi in 1961-1962 can no longer be found.

As an explanation, it was suggested that the rock shelf containing the carvings may have only become exposed relatively recently. It appears to have marked the original shoreline. A change in the stream channel, perhaps as a result of construction...
activities by the U.S. Army during World War II, may have resulted in the exposure of the rock shelf on which the carvings were made. It will be necessary to conduct further investigations, however, to ascertain whether in fact this was what happened.

Recommendations

Because there are no sites within the direct impact zone of the proposed harbor construction, there is no need to conduct further investigations prior to construction unless plans are altered. However, due to the proximity of the petroglyphs on Papaloa rock and their uncertain status as a prehistoric site, construction personnel should be advised of the need to avoid any damage to the site. In particular, heavy equipment should not be allowed on top of Papaloa rock.

There is the possibility that submerged archaeological deposits of an early age may exist below the coral deposits on the reef flat. This possibility cannot be evaluated, however, without dredging, which is the only way such deposits could become exposed for recording and study. Therefore, it is recommended that a professional archaeological monitor be present on a periodic basis during dredging to examine dredge spoils and collect and record artifacts and data should archaeological deposits be discovered. It will be critical that contingency funds be made available for the complete study of archaeological materials should they be found, along with the preparation of a technical report. Even if no archaeological materials are found, a technical report on relevant observations relating to stratigraphy and geology should be prepared.

Because harbor construction is expected to generate commercial growth in Leono and vicinity, and possibly an increase in population, it can be expected that there will be impacts to archaeological sites throughout the area, which are known to be widespread. It will be critical, therefore, that the appropriate governmental authorities in American Samoa be prepared to monitor this growth and take measures to find and evaluate historic and archaeological sites before adverse impacts occur.
Figure 1. U.S.G.S. map of Leone showing project area.
Figure 2. Proposed harbor construction plans. A more recent version incorporates some minor changes.
Figure 4. Map of Papaloa petroglyph site prepared by Kikuchi (1963:95).
Figure 5. Map of petroglyph Area A by Kikuchi (1963:96).
Figure 6. Map of petroglyph Area B by Kikuchi (1963:97).
Figure 7. Map of petroglyph Area C by Kikuchi (1963:98).
Figure 8. Map of petroglyph Area D by Kikuchi (1965:99).
Figure 9. Map of petroglyph Area E by Kikuchi (1963:102).
Photo 1. View of Leone Bay with Papaloa rock, Niuafo'ou islet is in the background, and Apolima Point is to the right.

Photo 2. View of shoreline between Papaloa rock and old stream channel on reef.
Photo 3. Modern script on Papaloa rock. Note very eroded date of 1966 above scale. Scale is 32 cm long.

Photo 4. Circular motifs on Papaloa rock. "SUE" is visible near left center above scale (compare with Kikuchi's map, Figure 7). Scale is 32 cm long.
Photo 5. Circular motifs and carved lines on Papaloa rock (compare with Kikuchi's map, Figure 6). Scale is 32 cm long.

Photo 6. Close-up of circular motif shown in top center of Photo 5. Scale is 32 cm long.
Photo 7. Whetstone site on basalt outcrop at Apolima Point.

Photo 8. Large basalt boulder used as whetstone. Note linear groove as well as oval grooves. Scale is 32 cm long.
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